



Earth System Research Laboratory
Physical Sciences Division



CO WATF, 17 March 2011
Denver

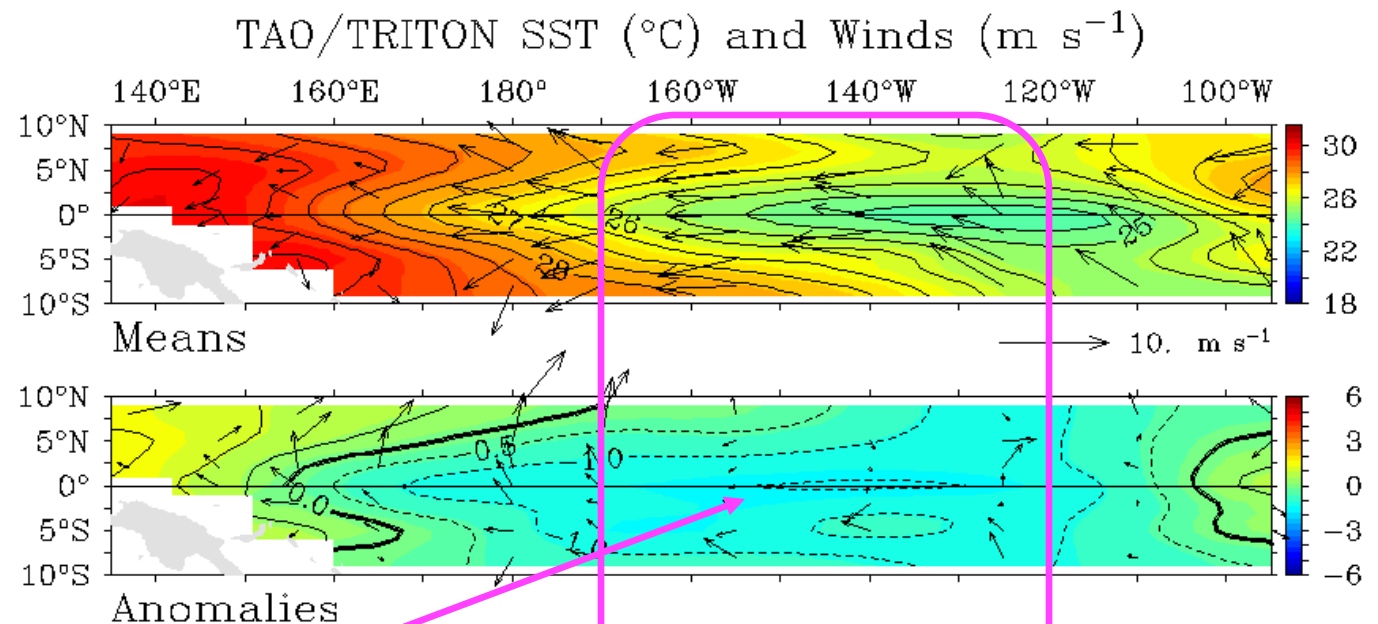
Seasonal Outlook into Summer 2011

Klaus Wolter

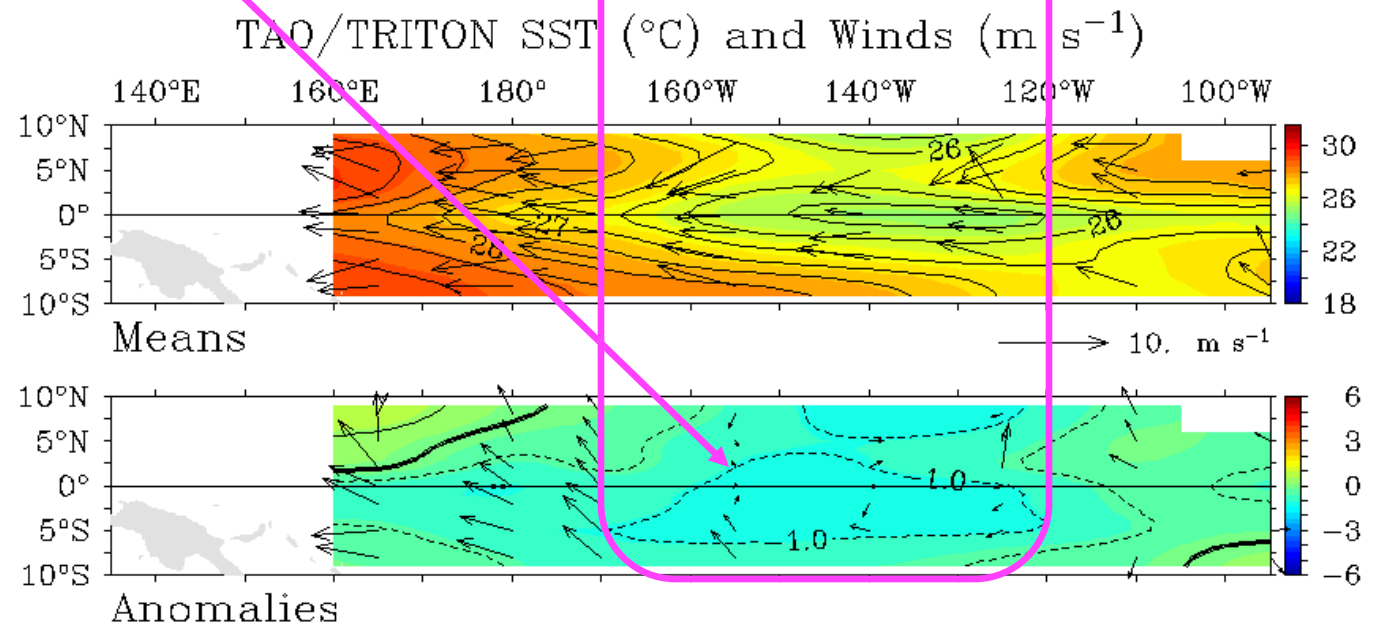
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- **La Niña still in control**
- **What will happen next with La Niña, and what does that mean for us?**
- **Expectations for next few weeks**
- **CPC forecasts for March through June 2011**
- **Experimental Seasonal Forecast Guidance**
- **Executive Summary**

Current state of El Niño/Southern Oscillation (ENSO) phenomenon (bottom), compared to last month (top): La Niña is not as strong as earlier this winter, but remains stronger than some people think (need to normalize data to account for time of year). Key elements that are still in place: strong trade winds near the dateline, below -1C in the equatorial Pacific, and above +1C north and east of Australia.

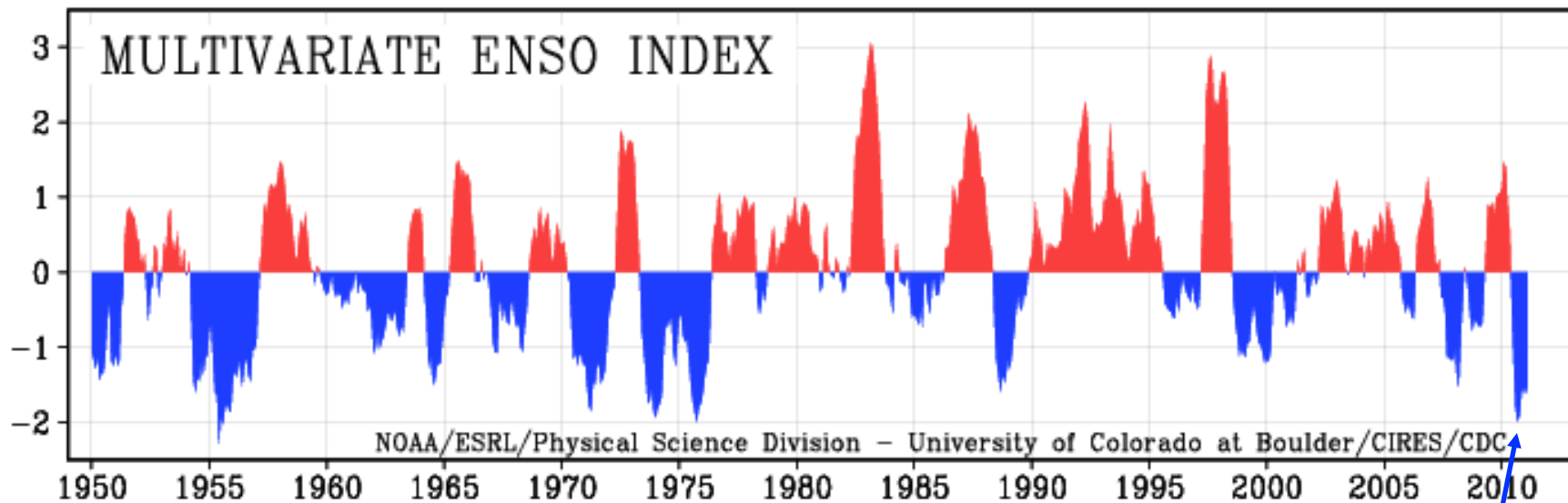


Five-Day Mean Ending on February 14 2011



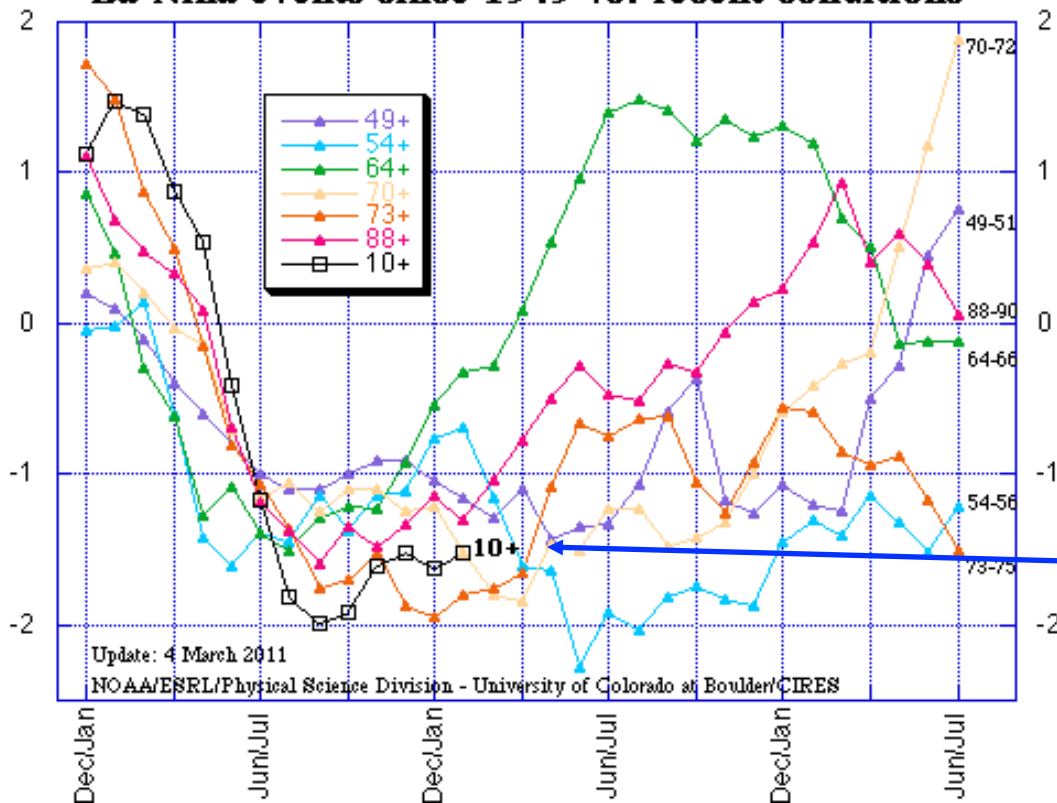
Five-Day Mean Ending on March 16 2011

Standardized Departure



Multivariate ENSO Index (MEI) for six strong La Niña events since 1949 vs. recent conditions

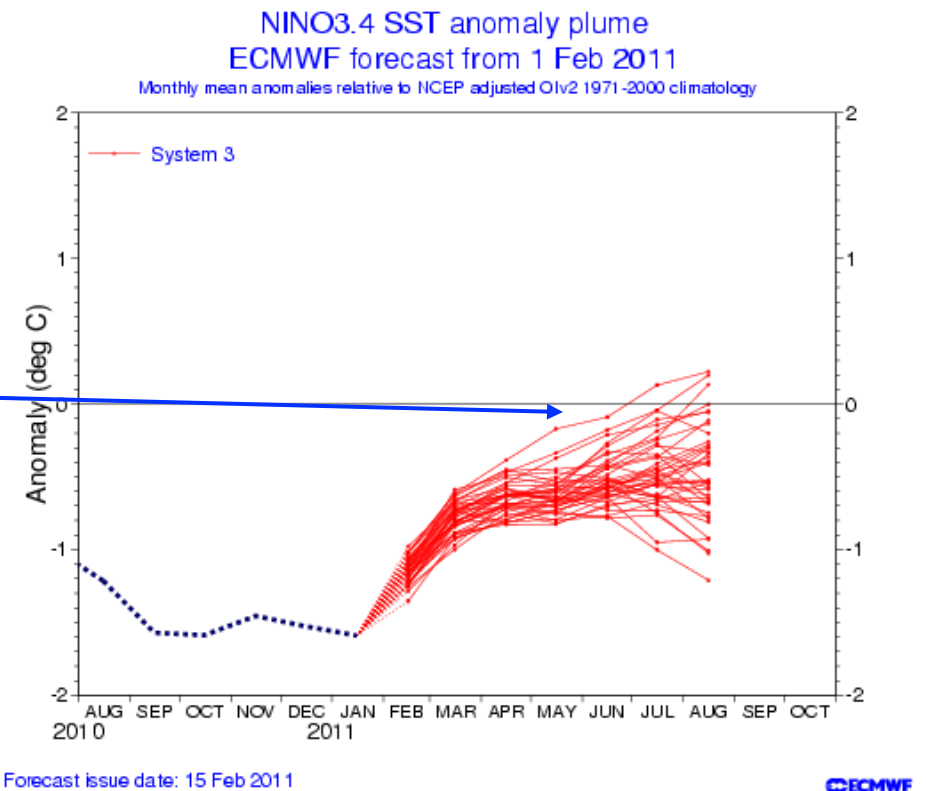
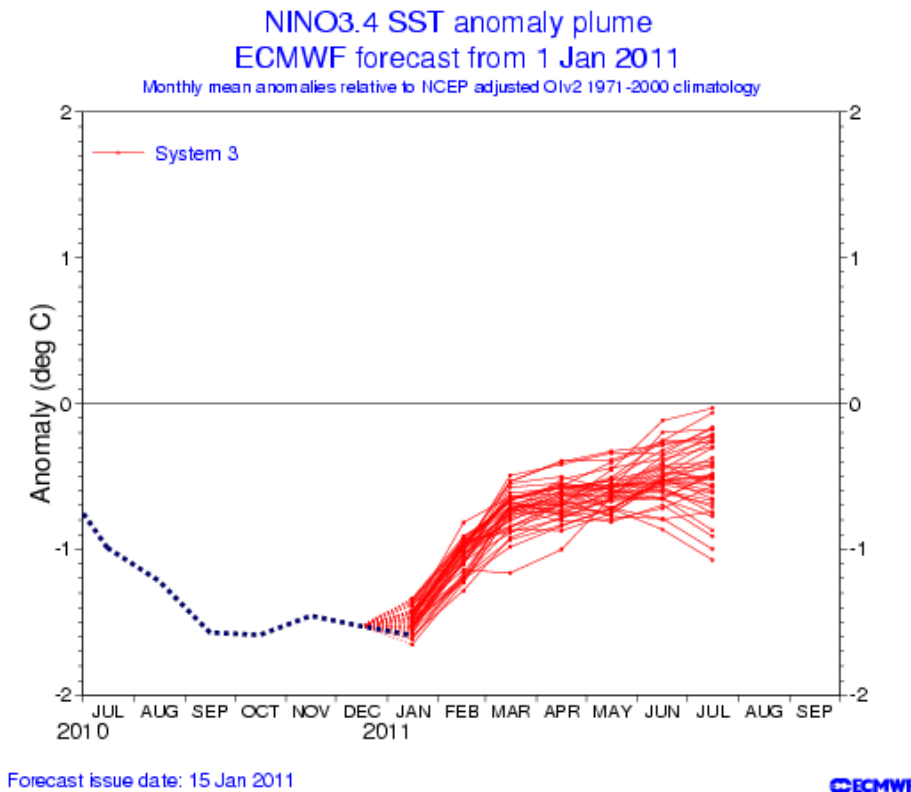
Standardized Departure



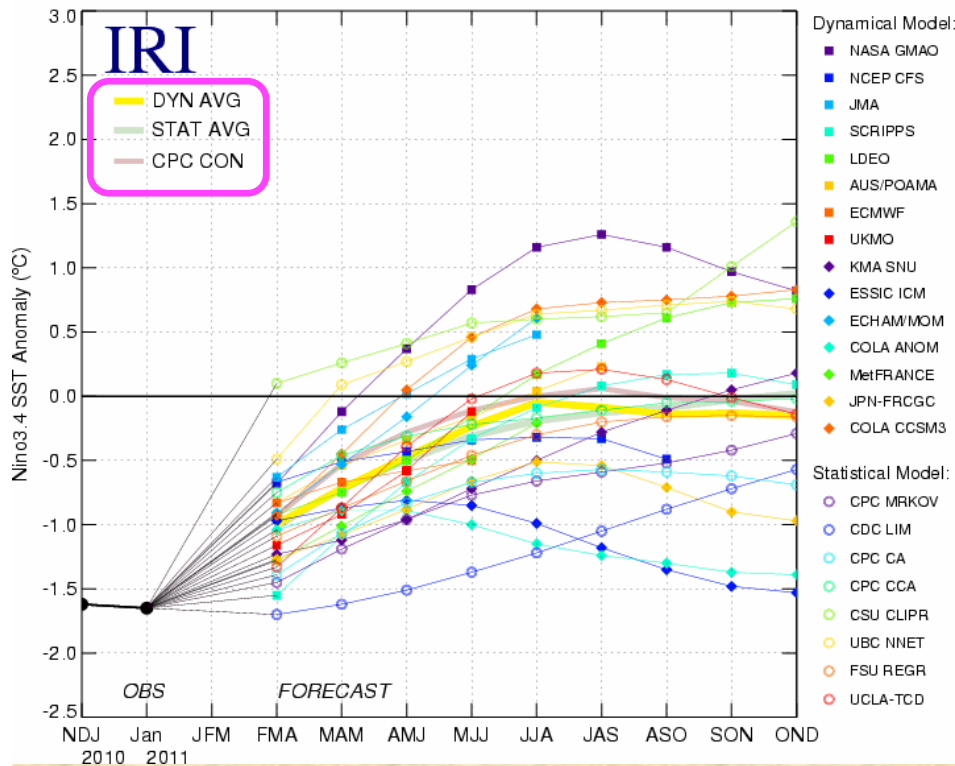
Record-fast drop in 2010 from good-sized El Niño to biggest La Niña event in 35 years in just half a year; continuing at high levels, mainly due to the atmosphere rather than the ocean.

The European model's January 2011 forecast (left) continued La Niña into the northern summer season, if somewhat weakened, with none of the ensemble members crossing into positive territory;

The European February 2011 forecast (right) kept all but 3 of its 50 ensemble members ('spaghetti plot') below 0C; once La Niña gets as big as this one, odds are higher than 50% that it ends up being a two-year event, even if it weakens during the summer.



Model Predictions of ENSO from Feb 2011

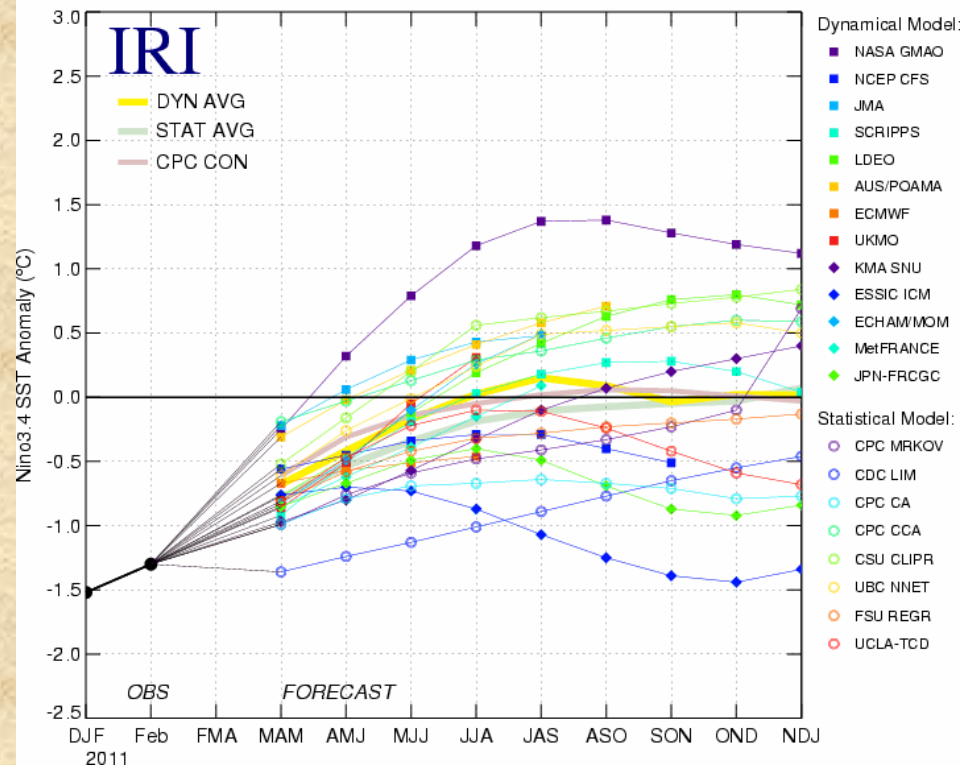


ENSO forecasts from 15 dynamical & 8 statistical forecast models from last month (left):

Expect weakening La Niña for next few months, then wide open outcome ('spring predictability barrier')...

On average, insignificant differences for statistical vs. dynamical models

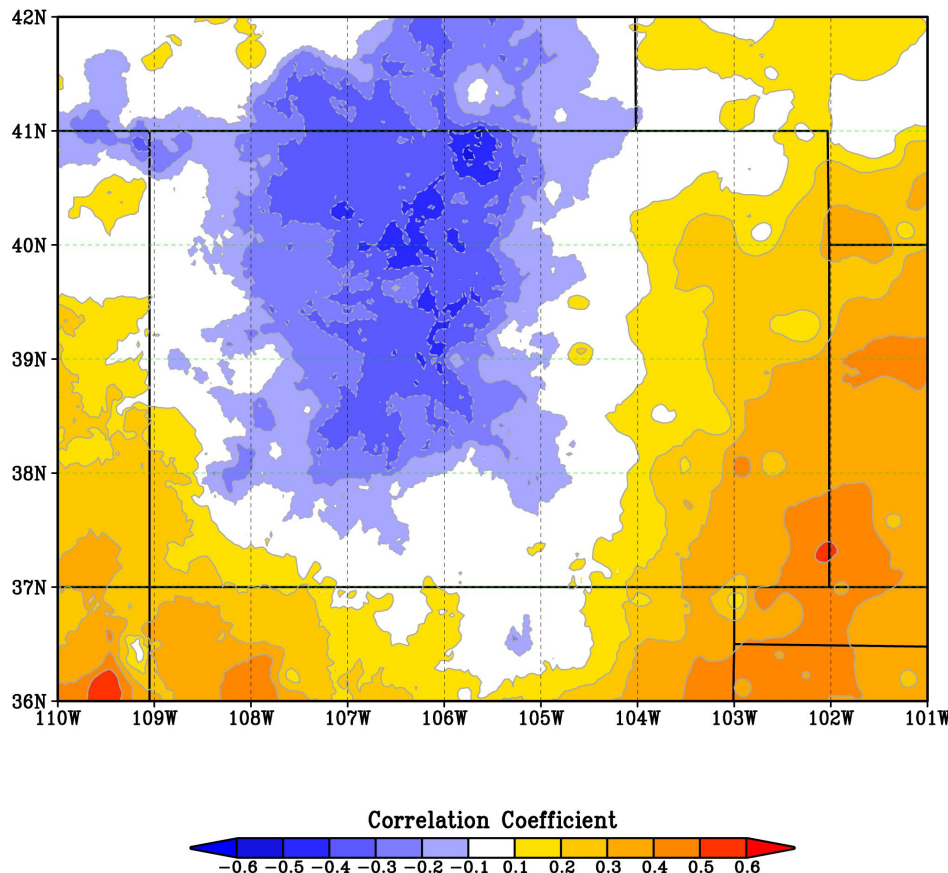
Model Predictions of ENSO from Mar 2011



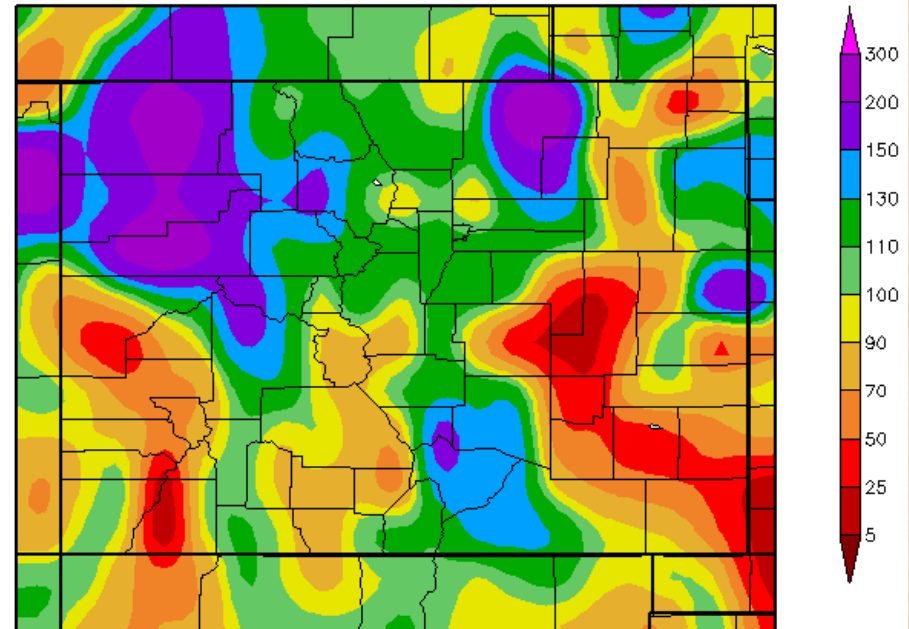
The most recent forecasts (right, 'incomplete') relax more towards neutral conditions by this summer; as I have stated before, these models are notoriously incapable of predicting multi-year events.

La Niña winters vs. Dec'10-Feb'11

DJF Precipitation versus MEI (1956–2005)



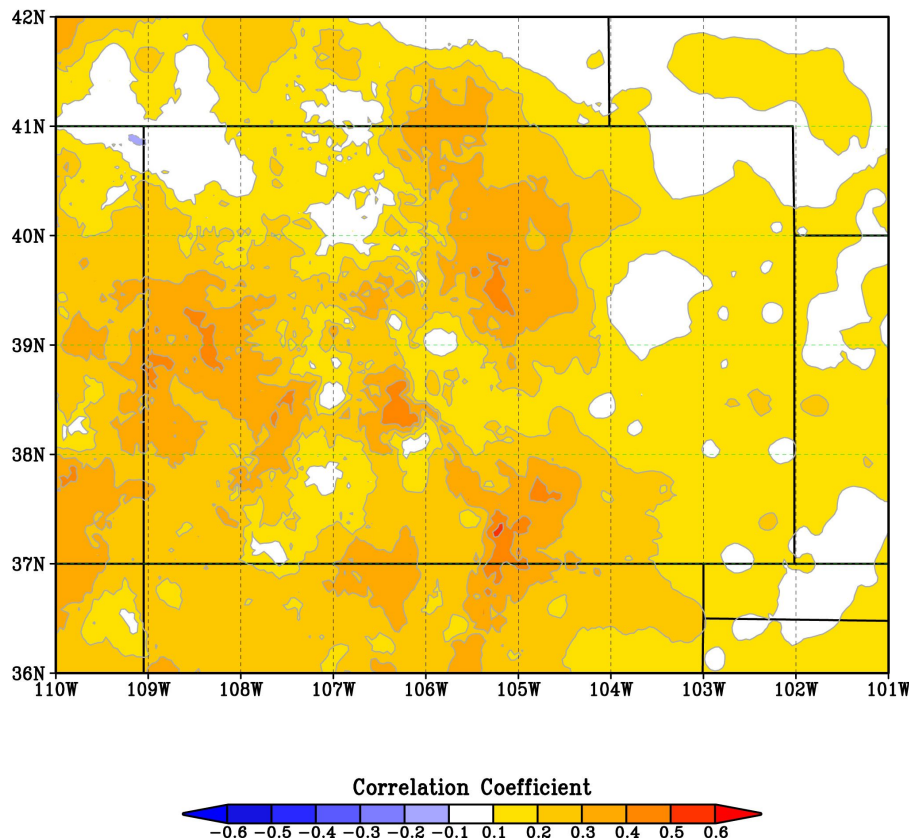
Percent of Normal Precipitation (%)
12/1/2010 – 2/28/2011



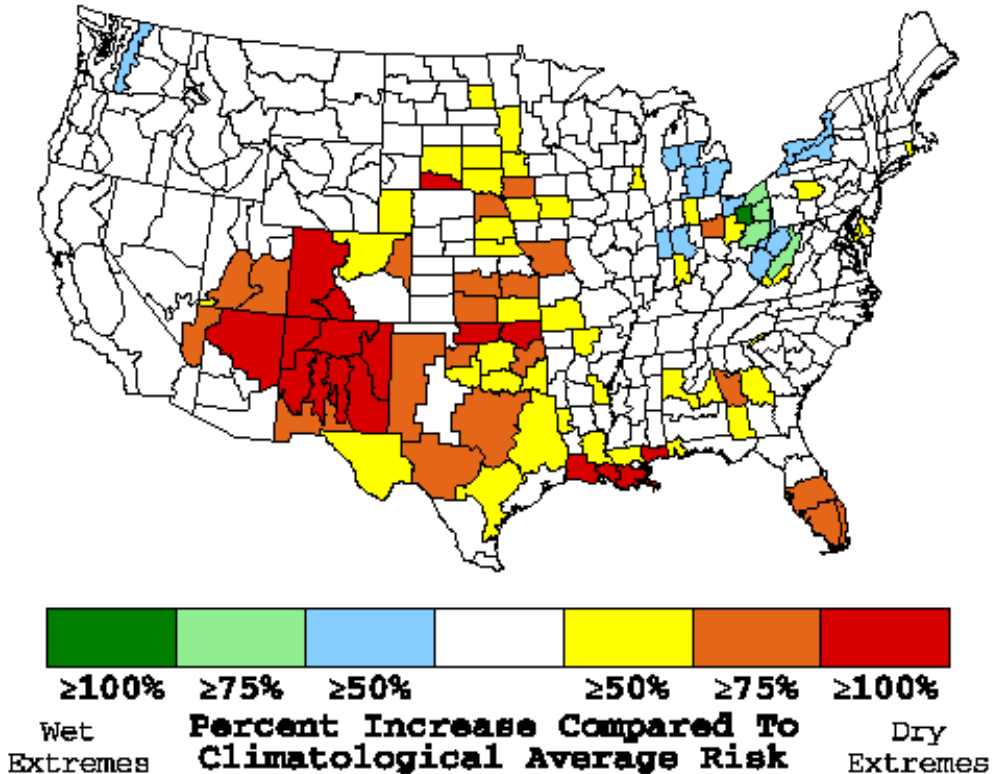
Our mountains tend to be WET with La Niña, reversing the typical footprint of La Niña during the rest of the year; this last winter has been wet indeed over the northern and central mountains, slightly on the wet side along the Front Range, and dry over SW and SE Colorado: *a well-behaved La Niña for us!*

La Niña springs

MAM Precipitation versus MEI (1956–2005)



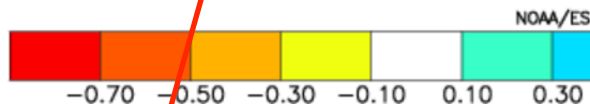
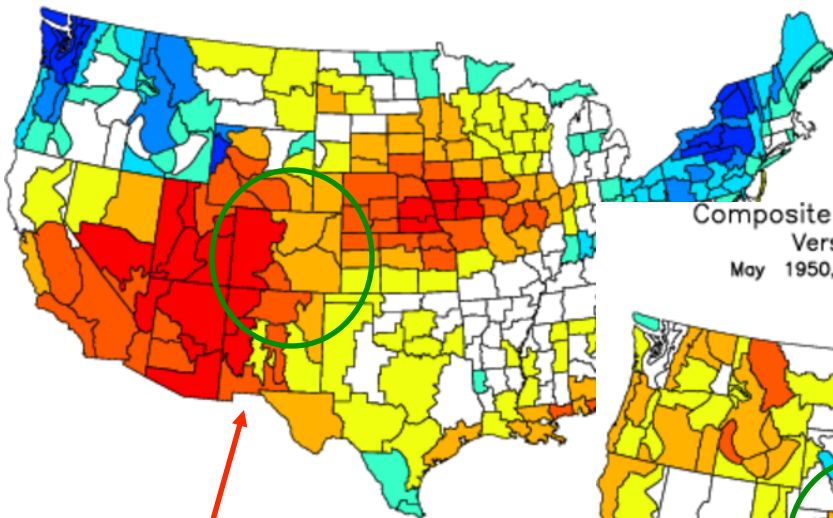
**MAM Precipitation Extremes During La Niña
Risk of Extreme Wet and Dry Years
DJF SOI**



Spring often goes back to being dry with La Niña, especially towards the Four Corners region. The weaker signal over eastern Colorado is thanks to 'quirkiness' of April signal (next slide).

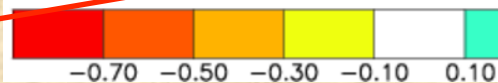
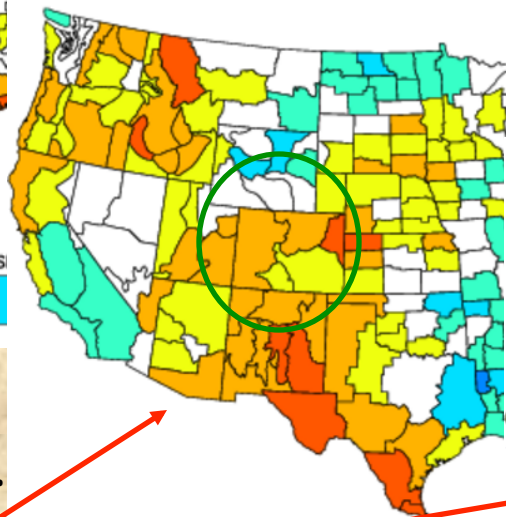
La Niña springs

Composite Standardized Precipitation Anomalies
Versus 1950–1995 Longterm Average
Mar 1950,1955,1956,1967,1971,1974,1976,1989,1999,2000
2008

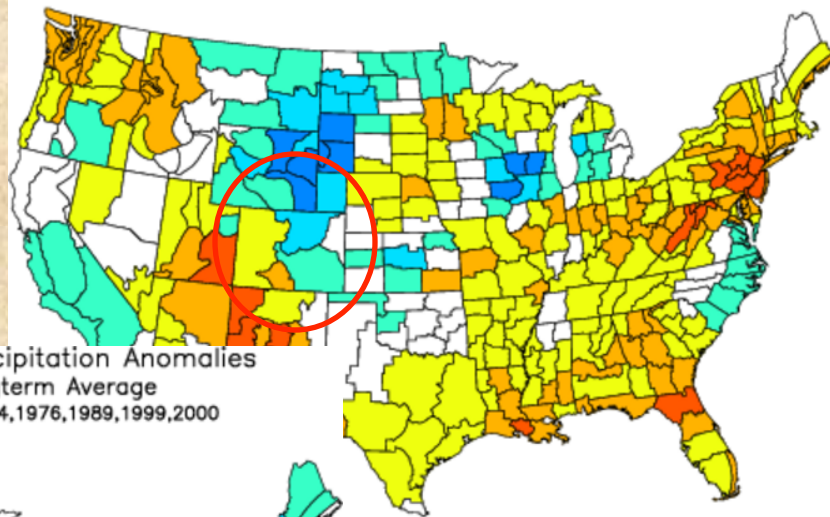


Individual spring months show typically dry behavior in March (top left), May (middle), and June (bottom right) in the wake of a La Niña winter, while April (top right) is another story, most recently in 1999.

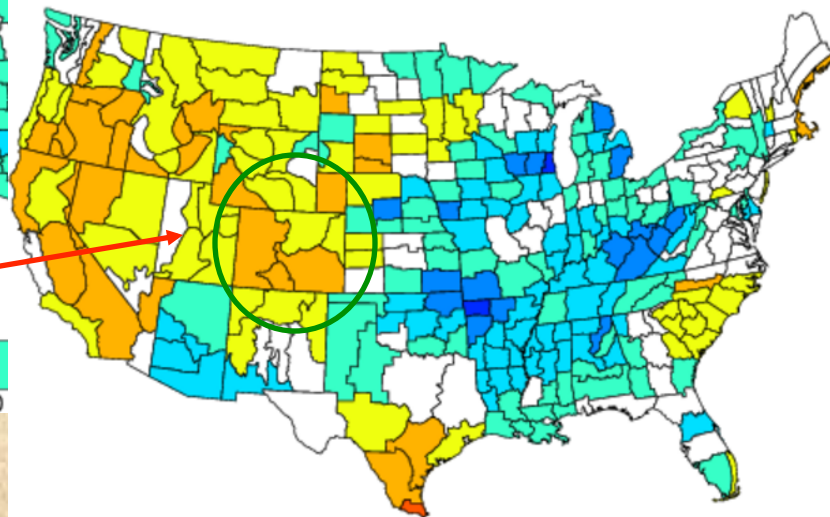
Composite Standardized Precipitation Anomalies
Versus 1950–1995 Longterm Average
May 1950,1955,1956,1967,1971,1974,1976,1989,1999,2000
2008



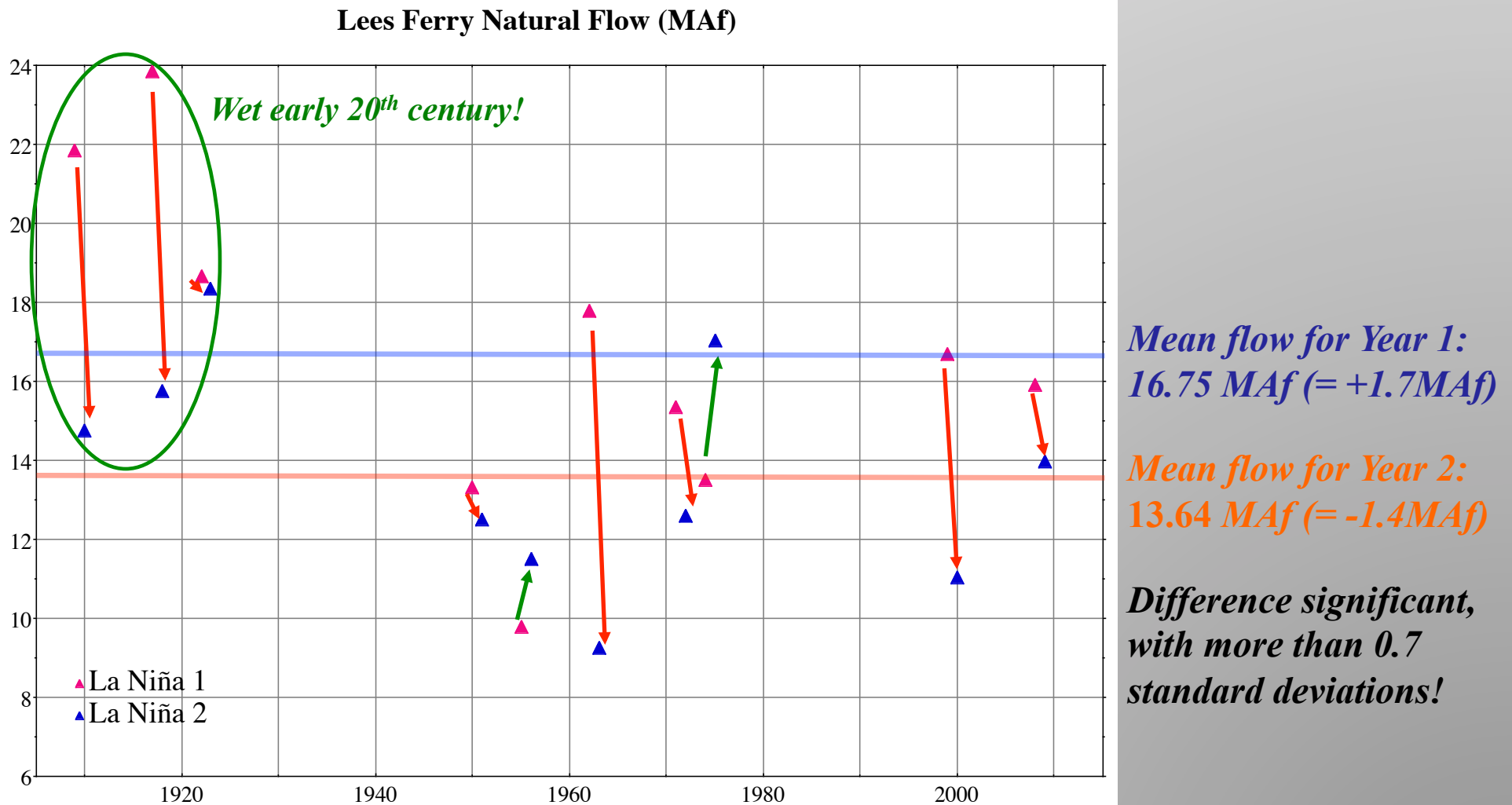
Composite Standardized Precipitation Anomalies
Versus 1950–1995 Longterm Average
Apr 1950,1955,1956,1967,1971,1974,1976,1989,1999,2000
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Composite Standardized Precipitation Anomalies
Versus 1950–1995 Longterm Average
Jun 1950,1955,1956,1967,1971,1974,1976,1989,1999,2000
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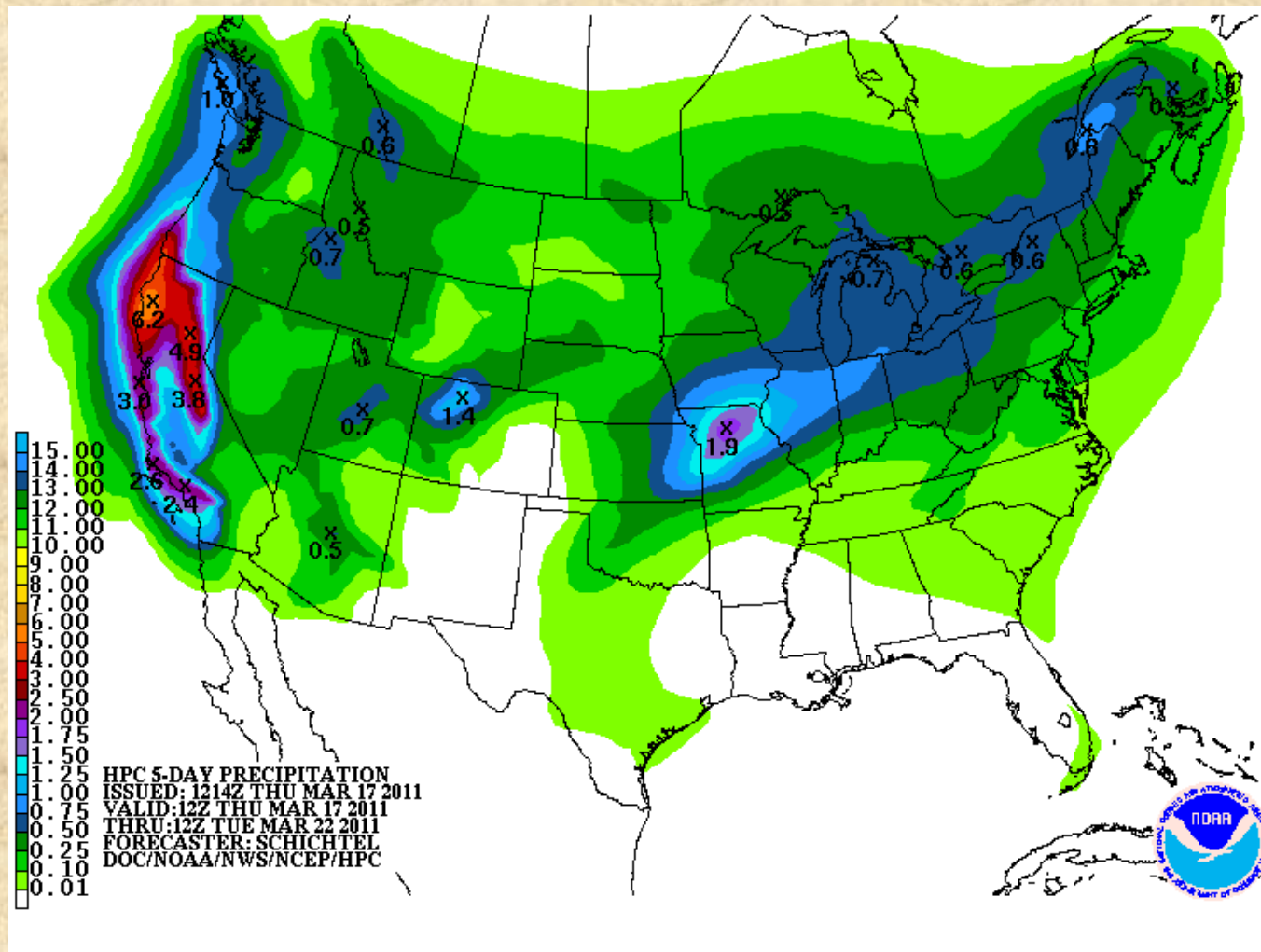


What is difference for Year 1 vs. Year 2 Las Niñas?



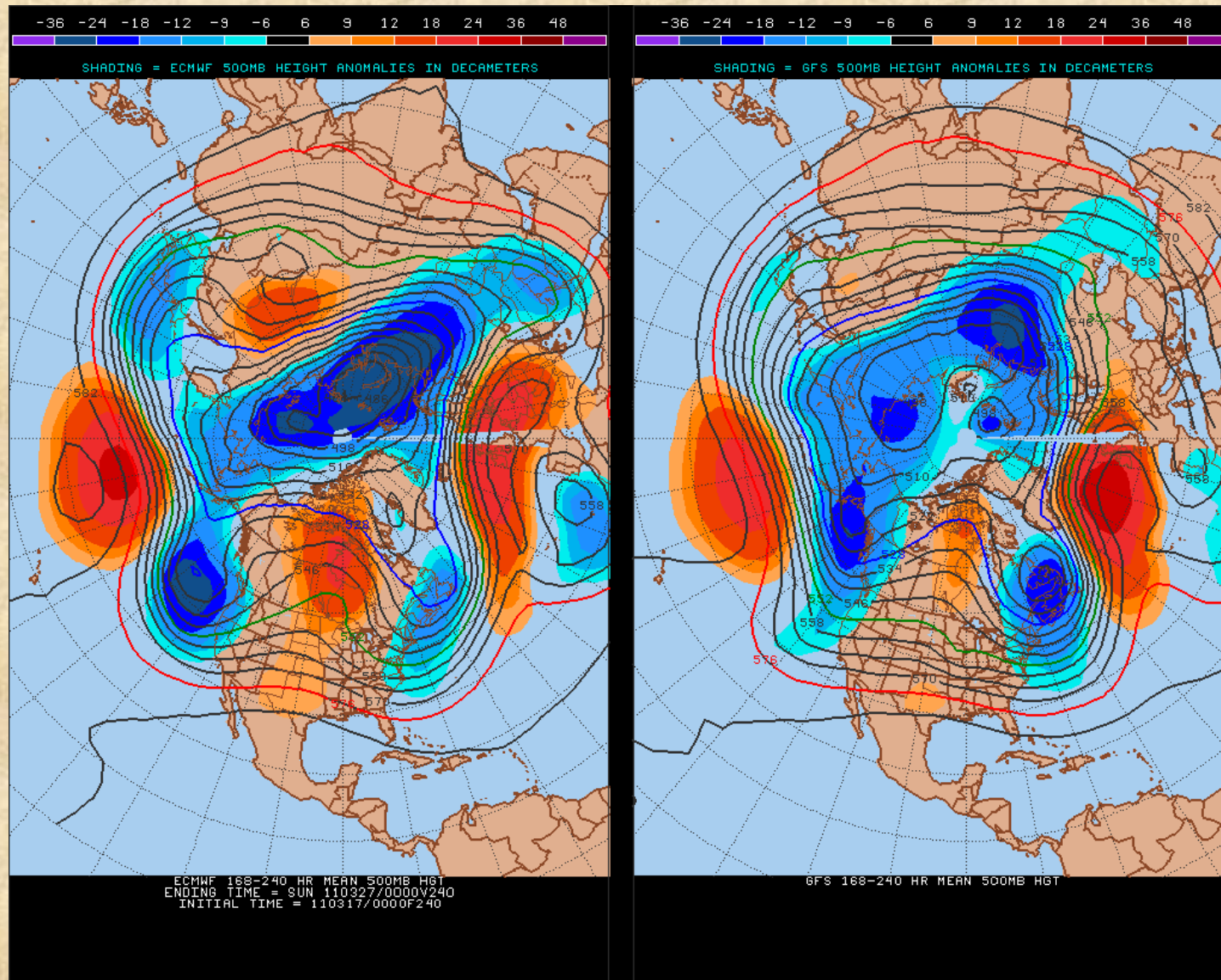
In two-year La Niña events, the 2nd year runoff has often been lower than 1st year runoff (8 of 10 cases) for the Colorado River. Six of these 1st year runoff totals were above the long-term mean, while seven of the 2nd year runoff totals were below that average.

What can we expect in the next five days?

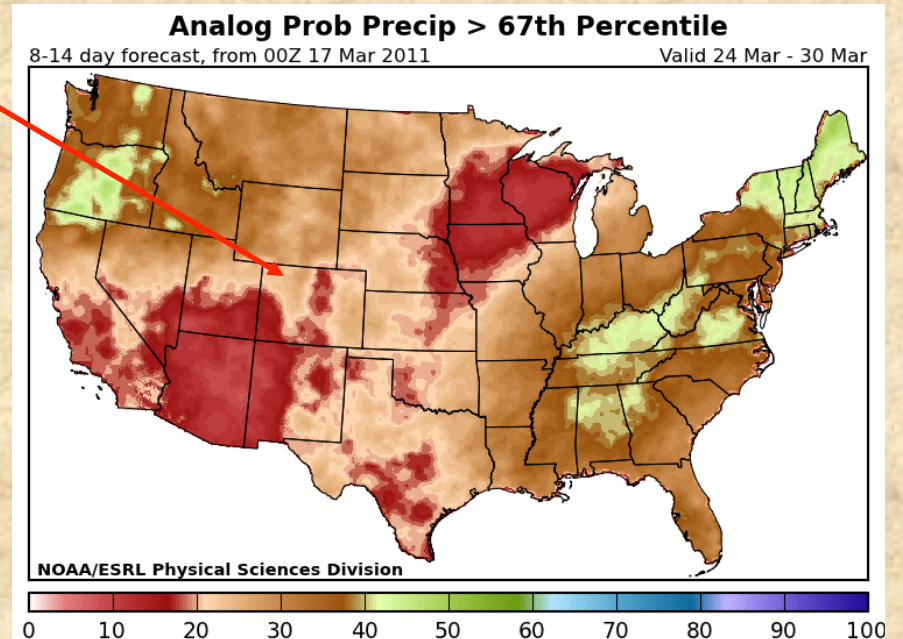
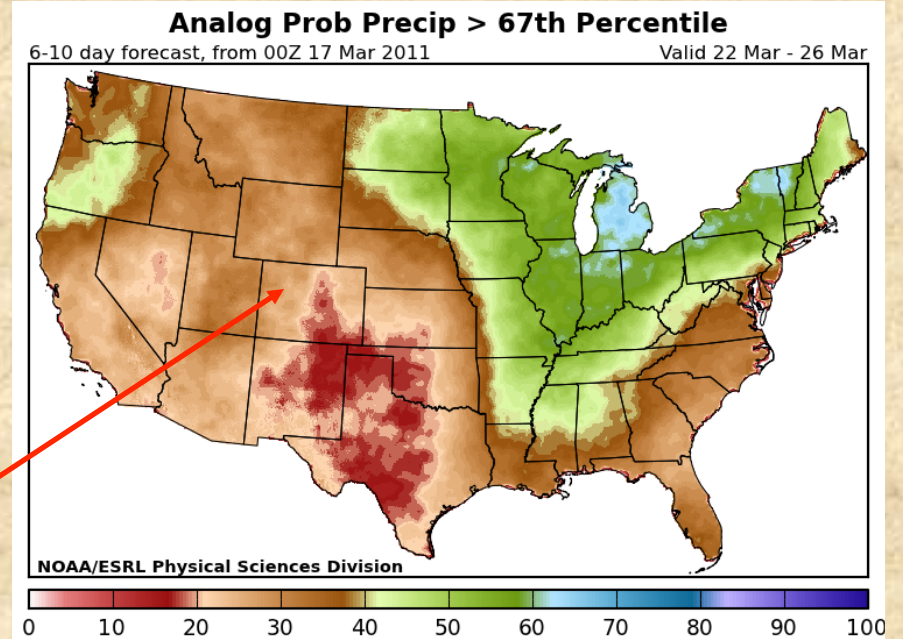
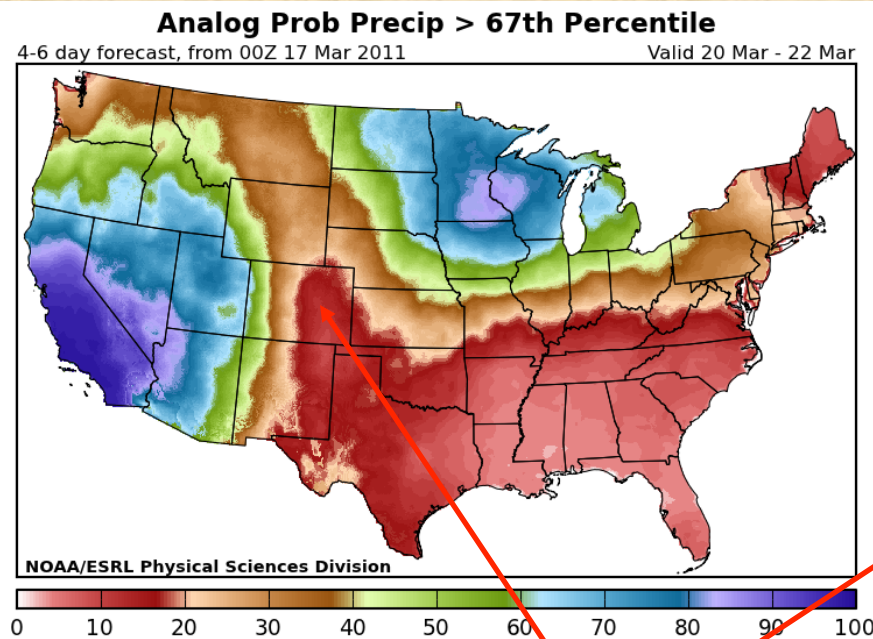


Expected total precipitation, according to Hydrological Prediction Center (NOAA-HPC) - matches template for most of the winter: wettest in northern mountains (*Winter Storm Warning for today into tonight*), with some spill-over into northeastern plains, driest in southeastern Colorado.

What can we expect next week?



What can we expect in the next two weeks?

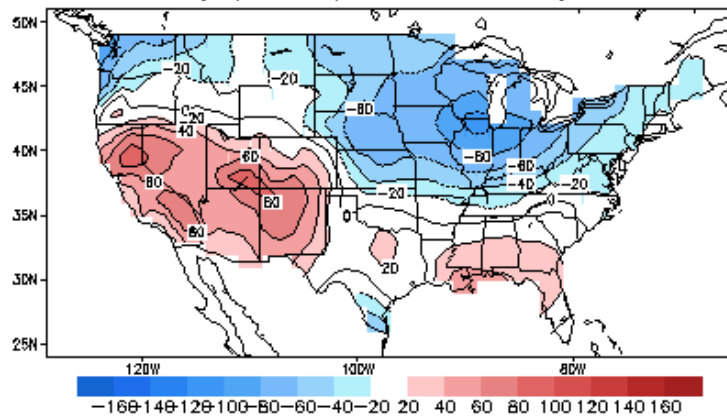


Precipitation chances for 4-6, 6-10, and 8-14 days from today show us on the southern edge of the storm track from CA into WI for next week (top); after that, a reversal to mostly dry conditions in “Week 2” (right), especially towards the Four Corners.

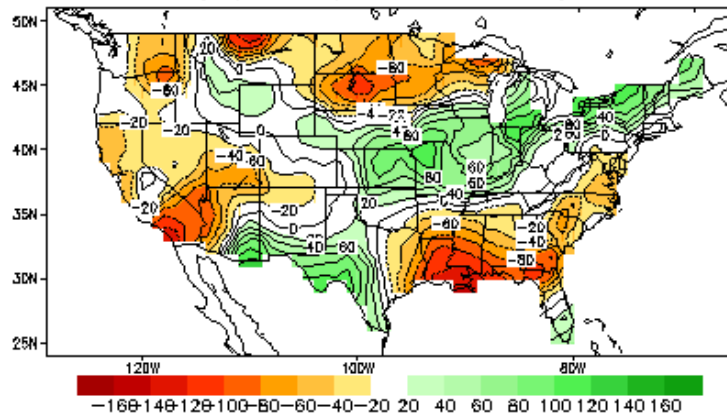
Temperatures are expected to oscillate between normal and warmer than normal levels, probably not lasting long enough on the high end to trigger early melting above 9K.

Climate Prediction Center 'Analog' Forecasts

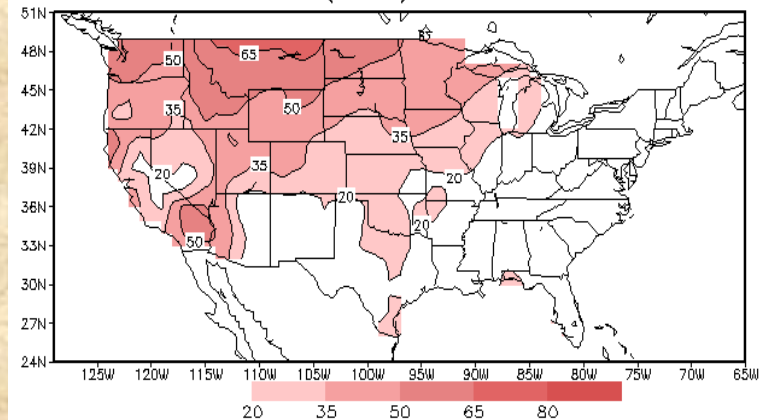
Lagged Averaged Temperature Outlook for AMJ 2011
units: anomaly (sdX100), SM data ending at 20110316



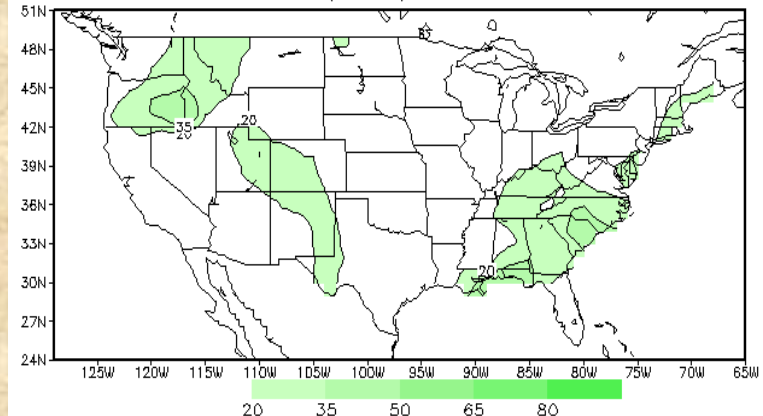
Lagged Averaged Precipitation Outlook for AMJ 2011
units: anomaly (sdX100), SM data ending at 20110316



lead 1 skill of temperature CAS forecast for AMJ
units: correlation (X100) based on 1981-2005

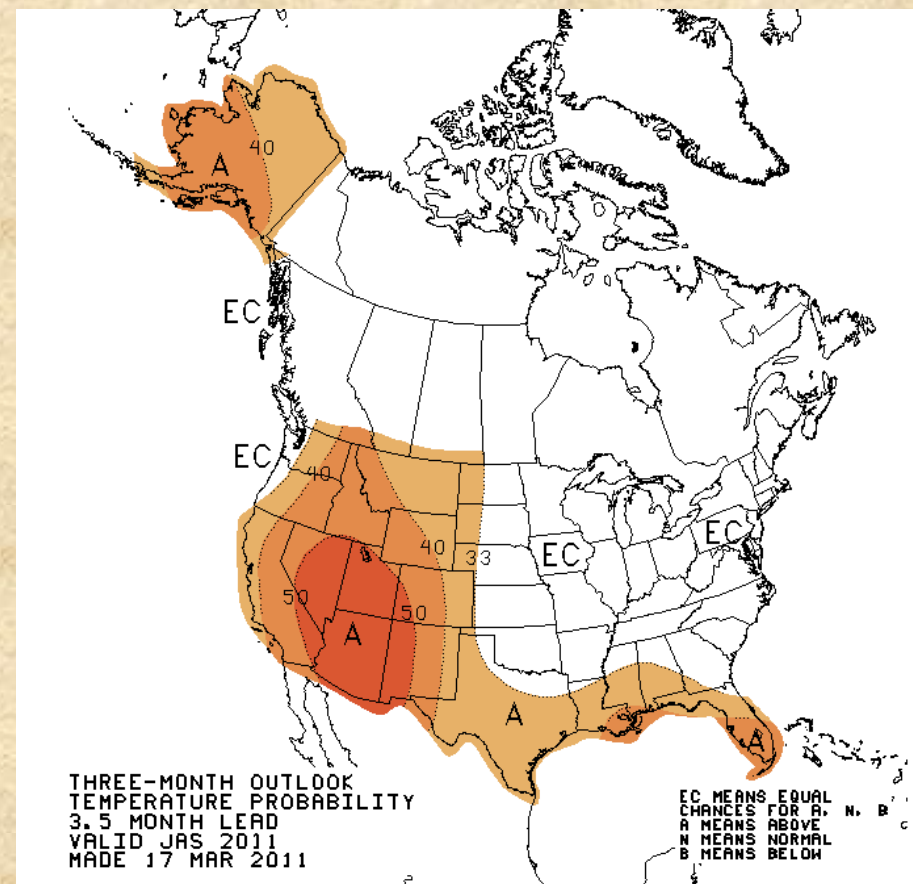
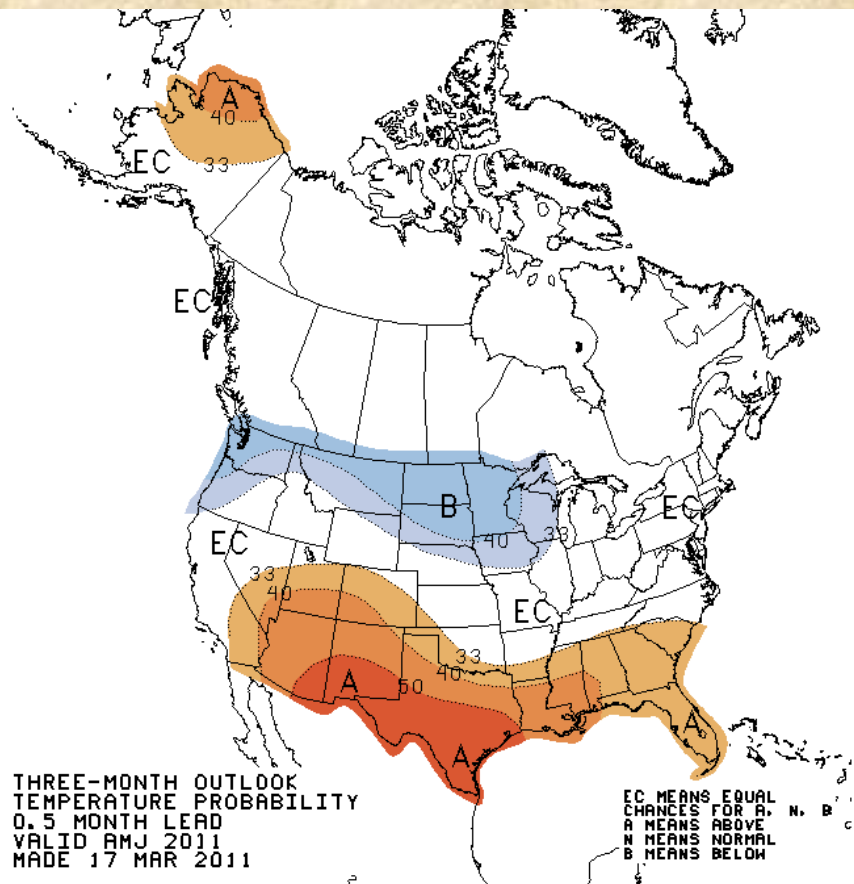


lead 1 skill of precipitation CAS forecast for AMJ
units: correlation (X100) based on 1981-2005



According to yesterday's soil-moisture analog forecast, northern Colorado looks to be favored over southern Colorado in April-June '11 (left) , along with above-normal temperatures towards the Four Corners. Skill level at this lead-time (right) is marginal for precipitation, better for temperatures. Source: <http://www.cpc.ncep.noaa.gov/soilmst/cas.shtml>

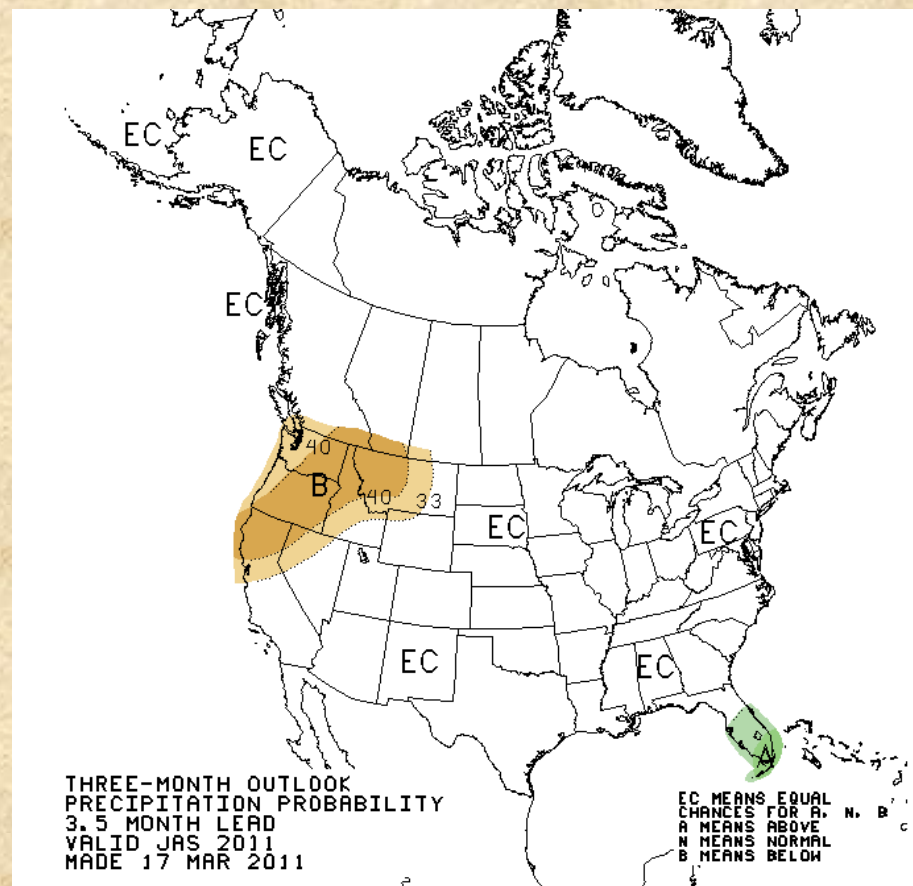
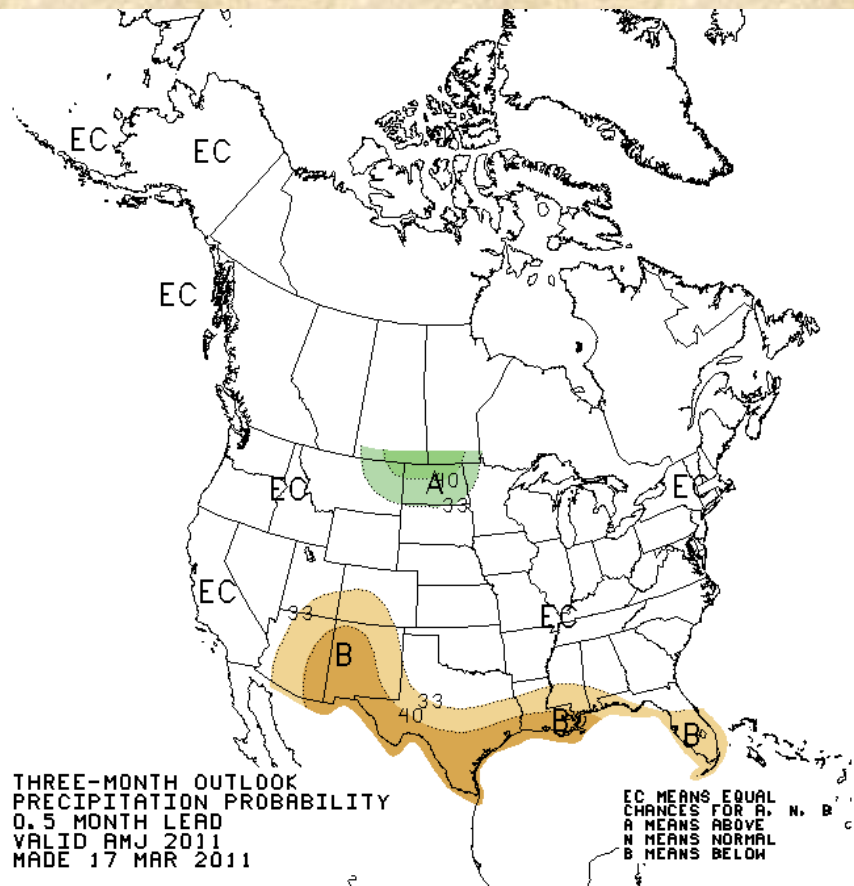
Climate Prediction Center Temperature Forecasts



According to today's CPC release, April-June (left) temperature forecasts show typical La Niña-based expectations, leaving Colorado with higher than average chances for a warm spring. Their temperature forecast for July-September (right) reverts back to long-term trends (WARMING) as its main tool, since ENSO-neutral conditions are anticipated.

Source: <http://www.cpc.ncep.noaa.gov/products/predictions/>

Climate Prediction Center Precipitation Forecasts



According to today's CPC release, April-June (left) precipitation forecasts show typical La Niña-based expectations, leaving southwestern Colorado with higher than average chances for a dry spring. Their precipitation forecast for July-September (right) reverts back to long-term trends (dry in Pacific Northwest, but 'EC' for us) as its main tool, given ENSO-neutral expectations.

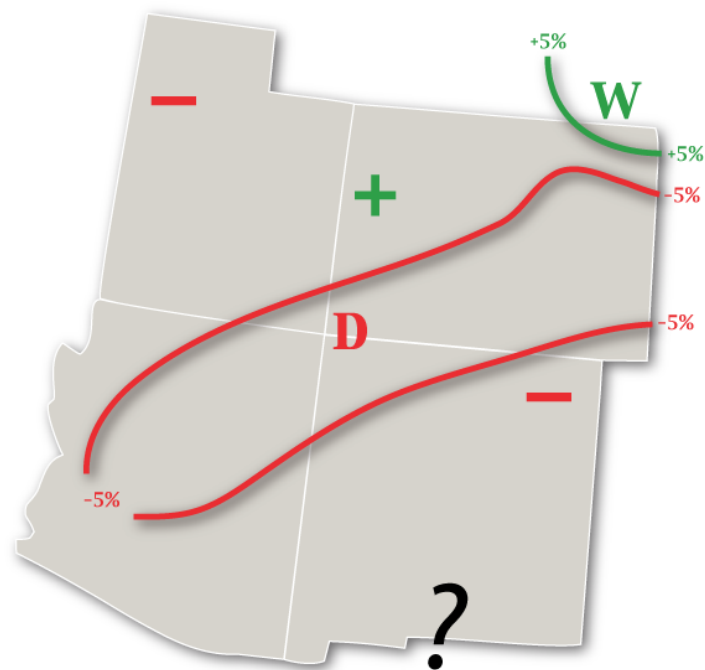
Source: <http://www.cpc.ncep.noaa.gov/products/predictions/>

Statistical Forecast for April-June 2011



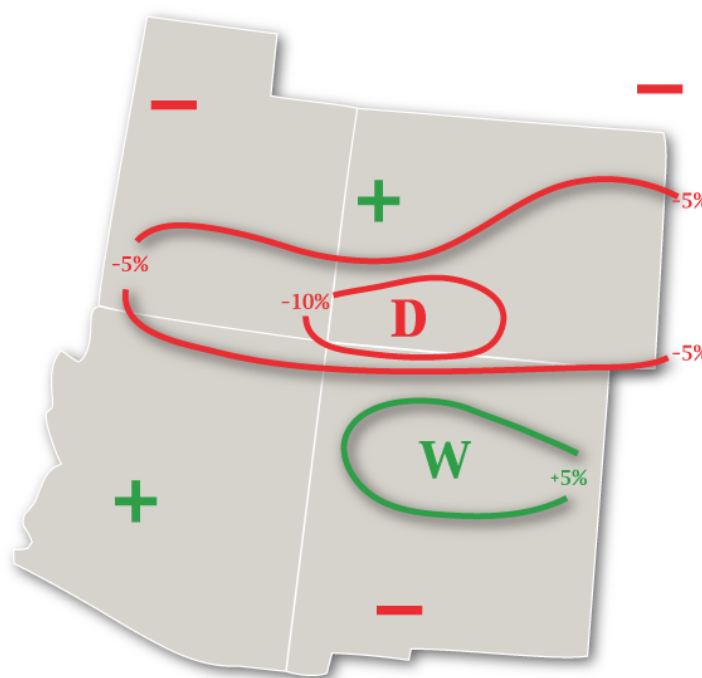
Experimental PSD Precipitation Forecast Guidance

APR – JUN 2011 (Issued February 15, 2011)

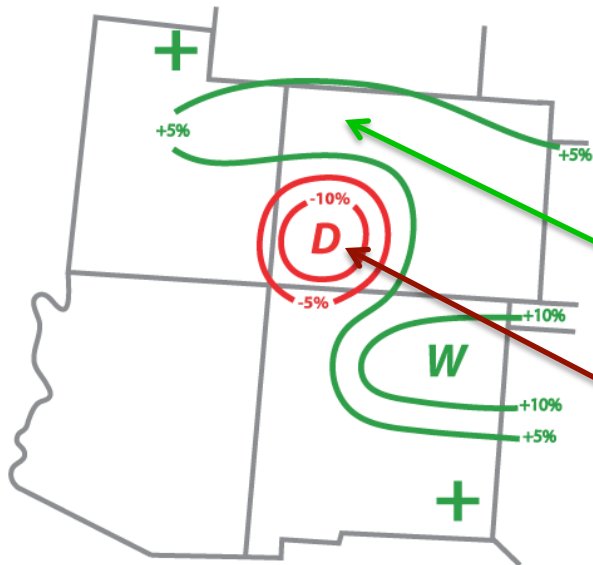


Experimental PSD Precipitation Forecast Guidance

APR – JUN 2011 (Issued March 11, 2011)

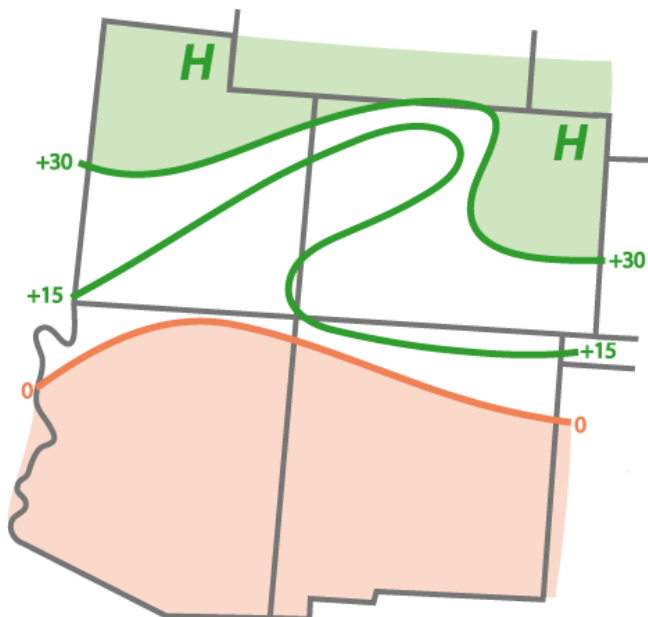


Last month's (left) and this month's (right) forecast for April-June 2011 is fairly confident that southern Colorado will see below-normal moisture. The northwestern third of our state has slightly increased chances of being wetter-than-average. *Historical skill over the last decade of experimental forecasts has been better over Utah and Colorado than to the south, or for most of the dry forecast regions rather than the wetter ones (see next slide).*

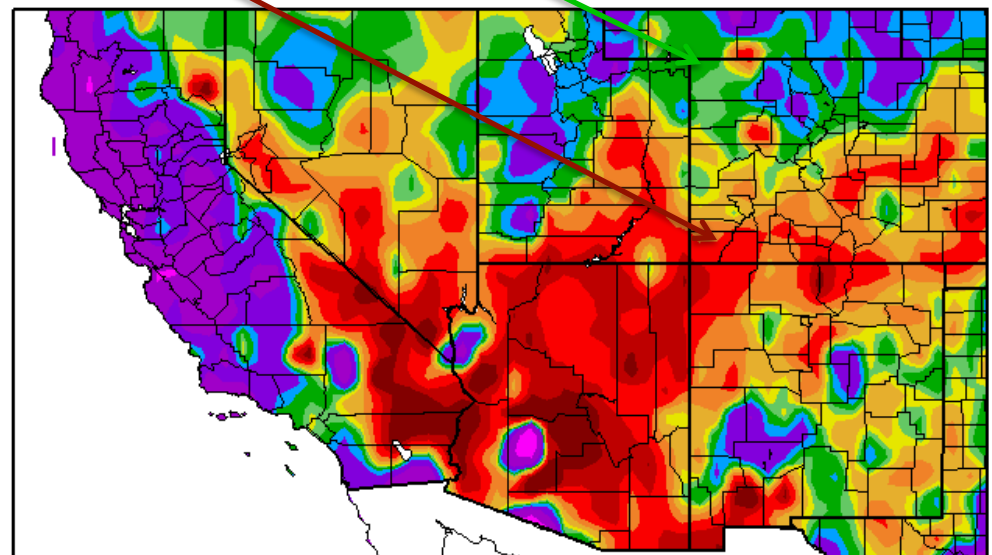


‘Flashback’ for April-June 2010

Forecasts for April-June 2010 from March (left) showed increased chances of above-average moisture for northern and eastern CO, in contrast to dry conditions in southwestern CO. Wet anomalies verified better over northern CO and UT than southeast of here, while dryness was more widespread than expected, *related to the rather fast onset of La Niña-like conditions?*



Percent of Normal Precipitation (%)
4/1/2010 - 6/30/2010



Notes on flooding risks in 2011

Time of year and amount of flooding in the Front Range [1864-1976]

May 1-10 1

May 11-20 3.5

May 21-30 5.5

May 31-Jun 9 9 **Combination of big spring storms with snowmelt**

Jun 10-19 6

Jun 20-29 2

Jun 30-Jul 9 2

Jul 10- 19 6

Jul 20-29 6.5

July 30-Aug 8 8.5 **Classic monsoonal peak with localized thunderstorms**

Aug 9-18 1

Aug 19-28 1

Aug 29-Sep 7 2

Sep 8-Sep 17 2

Source: <http://www.esrl.noaa.gov/psd/boulder/Boulder.flood.html>

Notes on flooding risks in 2011

Risk factors in 2011:

SNOWMELT-RELATED:

1. *Elevated snowpack in all but the southern ranges increases snowmelt potential*
2. *Reduced dust load (for now) reduces accelerated snowmelt risks (tentative), would affect southern mountains more than north*
3. *La Niña springs tend to be warmer than average, increasing risk of 5+day 'heatwaves' that can trigger 'meltsurges'*

FLASHFLOOD-RELATED:

1. *Some of the most prominent examples of flashflooding occurred during El Niño onset years ('65, '76, '97), while others did not ('99) – while it cannot be excluded that we could have an El Niño in 2011, I believe the odds for that are very low*
2. *Recent wildfires in Front Range in particular have lowered the threshold for flashflooding and mudslides – it will take several years to overcome this (Jamestown fire of October 2003 kept us busy for at least five years)*

Executive Summary (17 March 2011)

- 1. La Niña has been with us for more than half a year now, reaching strong intensity in the fall, and slowly weakening above the ocean surface. It might take a 'leave of absence' in mid'11, but odds are better than 50/50 for it to return later this year.**
- 2. Between lots of wind, wild swings in temperature, and a snowy winter in the northern and central mountains, as opposed to mostly dry conditions on the plains, La Niña has delivered typical impacts, including a mostly dry and warm start to March.**
- 3. My forecast for late spring (April-June) shows a tilt towards dryness covering the southern and eastern parts of our state, while near-normal or even wetter-than-normal conditions might linger over northwestern Colorado. Since La Niña springs have often been dry in Western Colorado, I would discount the latter forecast, and prepare for a dry spring all across the state. Best opportunity for relief from this expected dry spring may come in April along the Front Range.**
- 4. Given the mostly dry forecast for spring, I expect runoff to commence earlier than is typical for similar snowpack conditions at this time of year. Dust storms have been conspicuously absent so far, but may accelerate the meltout later on, especially in San Juans where 'heatwaves' are most likely this spring. I do not expect a sudden switch to El Niño which has been associated with increased flashflood risk in past summers.**
- 5. Bottomline: Count your blessings, this La Niña winter has delivered decent amounts of snow in our mountains which will lead to a good runoff season in much of our state. I am much less optimistic for local conditions over the eastern plains, nor do I expect a repeat performance for our mountains next year.**